

Freshwater Quality

The rivers and streams that flow into Puget Sound are the lifeblood of our region's ecosystems and our health, economy, and quality of life. Yet only 64% of the major rivers in Puget Sound meet water quality goals.

Clean water is vital to people and to healthy fish and wildlife populations. When our rivers and streams pick up pollutants, toxic contaminants, or excessive sediments and nutrients, it adversely affects the health of our watersheds, marine waters, swimming beaches, and shellfish beds.

Three key indicators help us monitor the health of Puget Sound: the number of impaired waters, the Water Quality Index (WQI), and the Benthic Index of Biotic Integrity (B-IBI). Under the federal Clean Water Act of 1972, waters that fail to meet water quality standards are considered impaired. The WQI integrates complex water quality data into a readily understood scale. The B-IBI measures the abundance and diversity of macroinvertebrates in a streambed. Also known as stream bugs, these creatures are a critical part of the aquatic food web and are sensitive to changes in the environment.

Freshwater Quality

INDICATOR:

Water Quality Index

Indicator lead: David Hallock, Washington Department of Ecology

TARGET:

At least half of all monitored streams should score 80 or above on the Water Quality Index.

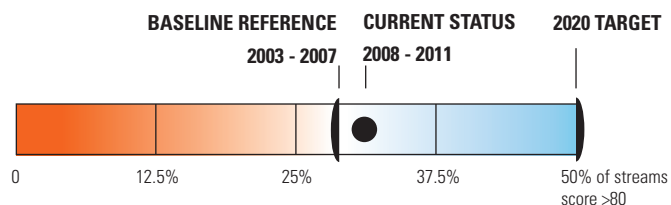
PROGRESS:

IS THE
TARGET MET?

NO

IS THERE
PROGRESS?

YES



During the 2003-2007 baseline period, 29% (16 of 55 stations) met the target value based on averaging index scores for each site during this period (Water Quality Index >80). During 2008-2011, 31% (17 of 55 stations) met the target value (a slight increase).

Progress Towards 2020 Target

There has been slight progress towards the 2020 target as monitored sites showed a very slight increase in the number of sites with Water Quality Index (WQI) scores of 80 or above. However, results from the trend analysis of 14 of the major rivers at their most downstream sites suggest that we are not likely to reach the target by 2020.

The earliest projection to meet the target for these 14 rivers would be 2025. When adjusted for differences in seasonal flows, the trend is much slower: average flow-adjusted scores of 80 are projected for 2060. Flow-adjusting accounts for the effect of flow on the parameters underlying the index.

However, this kind of estimate is a best guess due to fluctuations in drivers like the rate of population growth, global warming, and effectiveness of management activities, as well as possible long-term cycles not visible in the current 15-year dataset. For example, management tends to address the easier and more egregious problems first. As those problems get fixed, remaining problems become more difficult to correct with less effect on the water body for a given level of effort. Consequently, the rate of improvement in the index could be less, perhaps much less, than predicted by simply extending current trends.

What is This Indicator?

The WQI for rivers and streams combines eight measures of water quality. Expectations for four of the component measures (dissolved oxygen, pH, temperature, and fecal coliform bacteria) are tied to the State's Water Quality Standards for protecting aquatic life and contact recreation. The other four measures (nitrogen, phosphorus, suspended sediment, and turbidity) do not have numeric standards. Toxics are not included in the index.

Water Quality Index

Annual, 1994-2011

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Duckabush River nr Brinnon	94	92	96	78	92	89	93	95	94	90	74	94	89	85	88	96	86	89
Skokomish River nr Potlach	88	93	87	86	75	87	95	95	94	85	70	67	92	89	89	94	86	70
Snohomish River at Snohomish	83	77	82	76	89	83	92	91	89	81	74	75	89	75	81	85	79	77
Elwha River nr Port Angeles	83	83	79	80	87	74	86	88	83	76	73	74	89	67	66	81	81	76
Cedar River at Logan st/Renton	81	76	68	75	65	83	87	76	60	78	72	84	81	79	79	81	77	75
Skagit River at Marblemount	90	78	75	64	87	71	87	86	59	85	64	81	84	75	75	81	56	77
Skagit River nr Mount Vernon	75	73	72	65	84	77	89	91	71	76	61	73	77	77	75	76	74	73
Nisqually River at Nisqually	65	74	58	59	76	60	40	60	79	79	69	71	74	75	91	74	83	86
Deschutes River at East St Bridge		67	74	47	61	62	62	72	70	73	61	83	88	88	82	76	74	60
Stillaguamish River nr Silvana	83	70	66	58	71	70	81	60	44	72	55	67	71	69	75	75	71	59
Green River at Tukwila	62	52	35	50	63	70	82	73	66	67	75	49	72	68	60	69	63	68
Samish River nr Burlington		66	59	50	58	66	86	75	32	49	34	71	67	74	59	80	63	52
Nooksack River at Brennan	73	56	49	41	62	42	65	68	58	57	52	54	61	51	60	69	56	55
Puyallup River at Meridian St	49	52	47	48	41	62	60	58	57	55	51	58	59	58	61	49	62	56

Table 1. Annual WQI scores for monitoring stations near the mouth of 14 major rivers. Scores are calculated for each water year from October 1st to September 30th. Higher numbers indicate better water quality. Scores 80 or above are shown in green, 70 to 79 in orange, 40 to 69 in pink, and scores 39 or less are in red.

Index values are based on monthly monitoring at individual stations. The index values range from 1 to 100; a higher number is indicative of better water quality. However, a particular station may receive a good WQI score, and yet have water quality impaired by parameters not included in the index. Similarly, some locations may have poor WQI scores based on measures that do not have Water Quality Standards.

Interpretation of data

Status and trend

From 2008-2011, 17 of the 55 long-term monitoring stations reported average WQI scores of 80 or more, indicating that they support water quality goals for conventional pollutants (toxics are not included); 11 stations had values that were "borderline" (70 – 79); 25 had "poor" scores (40 – 69); and two stations had a very poor index score (< 40) (Figure 1). For major rivers, three out of 14 stations reported average WQI scores of 80 or higher during this time period (Table 1).

Freshwater Quality

WQI scores for major rivers in Puget Sound are in the mid 70s. These scores have slowly improved at a rate of about 0.4 units per year since 1995 (seasonal Kendall analysis, $p < 0.10$). Flow-adjusted scores have improved at a slower rate, 0.16 units per year ($p < 0.20$).

Scores have improved most strongly in the Nisqually and Deschutes systems (1.4 and 1.6 units per year, respectively, $p < 0.05$). No Puget Sound basins have had significantly declining scores ($p > 0.20$).

In addition to improvements in the overall scores for major rivers in Puget Sound, fecal coliform bacteria and total nitrogen index scores have improved. Other parameters are unchanged in freshwater systems as a whole, though there may be system-specific trends.

Stations meeting water quality goals are all in the relatively undeveloped Olympic Peninsula, except for the Snohomish River. Stations not meeting water quality goals tend to be in watersheds with more people and more agricultural development.

**Freshwater Quality Index scores (averaged)
for 55 sites in Puget Sound
2008-2011**

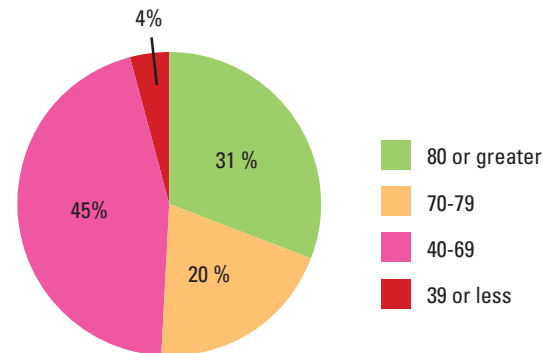


Figure 1. WQI scores (averaged) from 2008-2011. Shown are percentages of 55 sites by category for WQI. Higher numbers indicate better water quality.

Sources: Statewide Water Quality Monitoring Network, Washington Department of Ecology; Stream and River Water Quality Monitoring, King

INDICATOR:

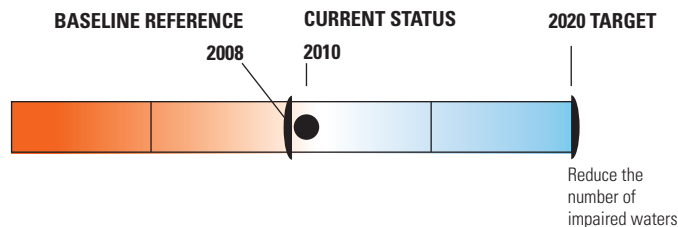
Number of Impaired Waters

Indicator lead: Ken Koch, Washington Department of Ecology

TARGET:

Reduce the number of “impaired” waters

PROGRESS:

IS THE
TARGET MET?**NO**IS THERE
PROGRESS?**YES**

From 2008–2010, the number of impairments decreased from 1573 to 1496 (a difference of 77). However, the next assessment (due in 2013) is expected to show a significant increase in impairments (a trend away from the 2020 target) due to an increase in data and the number of sites assessed.

Progress Towards the 2020 Target

Although the number of impairments for rivers and streams decreased by 77 segments in 2010 (Figure 1), it does not mean that these segments now meet water quality standards. Instead, the change in number of impairments was largely due to the number of segments receiving approval for their water quality improvement project plans or pollution control programs.

Having a plan in place removes a segment from the impairment list, but does not necessarily mean that the area has been restored or that water quality standards are being met. For example, only four segments from the 2010 list were removed from the impaired list because they met water quality standards.

New data for freshwater were not reviewed in 2010; the next water quality assessment for 2012 will use new data and be published in 2013. The number of freshwater impairments is likely to rise significantly in 2012 due to an increase in data and the number of sites assessed. Comparing the number of impairments for 2008 to 2012 will be difficult because the method used to map and count segments will change.

What is This Indicator?

Impaired waters are segments of streams, rivers, or lakes that do not meet Washington State’s Water Quality Standards for bacteria, dissolved oxygen, temperature, toxics, or other pollutants. Cool, clean water is a key ingredient for a healthy Puget Sound. When lakes and streams have a reduced ability to support native species and human uses, then they are listed as Impaired.

Washington Department of Ecology reviews data from a variety of sources every four years to identify impairments. The data used to list segments as impaired must meet rigorous data quality standards as outlined in

Freshwater Quality

Washington's Water Quality Policy 1-11.

Under the Federal Clean Water Act of 1972, waters are considered impaired when they fail to meet water quality standards or minimum requirements for certain uses. Every two years, states are required to prepare a list of water bodies that do not meet water quality standards. This list is called the 303(d) list, because the process is described in Section 303(d) of the Clean Water Act. To achieve this goal, Washington State established water quality standards designed to protect and restore water quality for drinking, recreation, and habitat for fish and other aquatic life.

More than one segment of a river may be listed as impaired, and a single segment may be listed for more than one pollutant. Once a segment is listed as impaired, a plan must be created and implemented to control pollution or improve water quality. The effects of these restoration programs can take many years to have a positive impact.

Interpretation of Data

Status and trend

In the Puget Sound basin, the 2010 Water Quality Assessment showed a total of 6,957 segment and parameters combinations were assessed. A total of 1,496 river and stream segments, in 525 rivers and streams, did not meet Water Quality Standards and thus were listed as impaired.

Impairments occurred in all 19 Water Resource Inventory Areas (WRIAs) in the Puget Sound basin (Figures 2 to 4). More than 60% of the total number of listings for Puget Sound rivers and streams were in five watersheds: Nooksack (296 listings), Kitsap

**Number of stream and river segments listed in each assessment category
2008 and 2010**

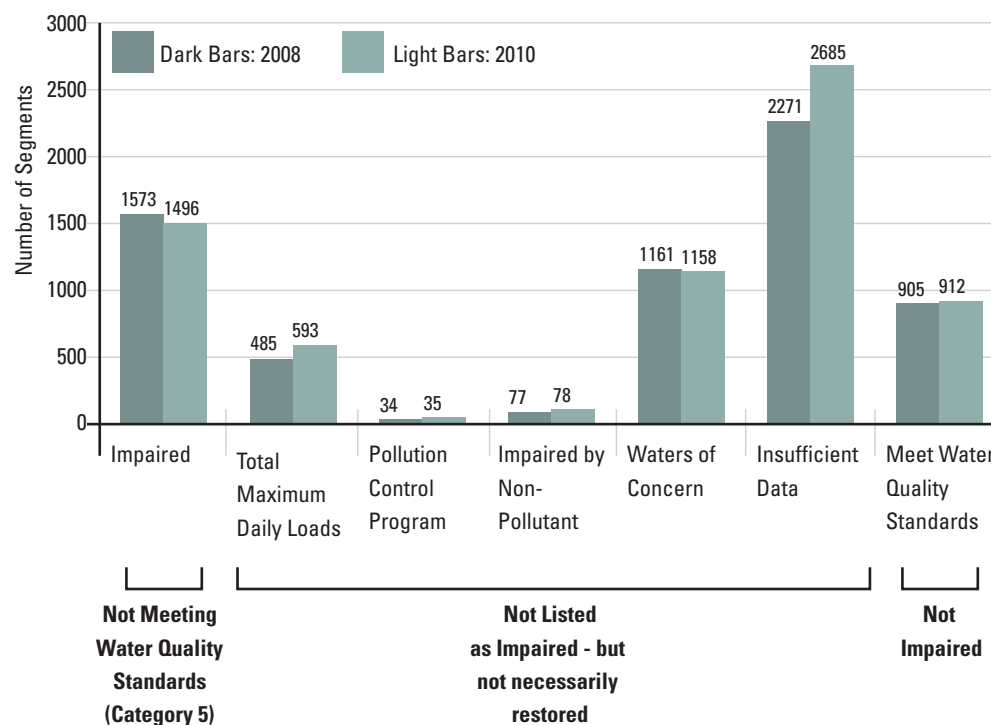


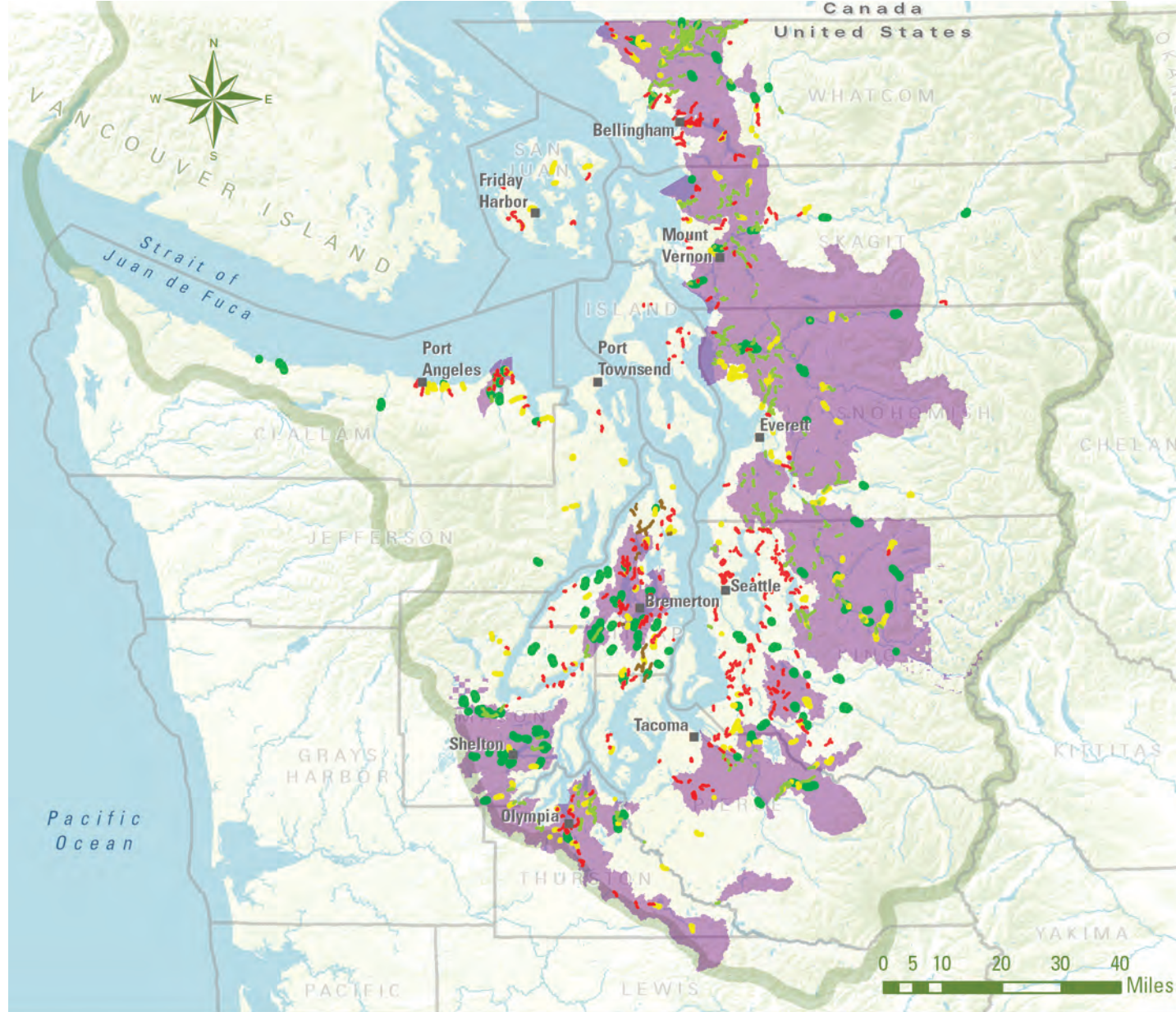
Figure 1. Number of stream and river segments listed in each assessment category for 2008 and 2010. Category assignments are from Washington Department of Ecology's Water Quality Assessment process for Puget Sound watersheds. The 2010 Assessment was focused on marine waters and, therefore, showed minimal changes to freshwater listings.

Source: Washington State's Water Quality Assessment and 303(d) list.

(194), Cedar/Sammamish (181), Duwamish-Green (132), and Lower Skagit-Samish (109). For Puget Sound lakes, 52 were listed as impaired; 48% were listed for bacteria and total phosphorus, and approximately one half were listed for toxic chemical contamination.

The most frequently cited data for listing segments as impaired were bacteria (524 listings), dissolved oxygen (460), temperature (353), and pH (97). However, the largest number of segments (39%) could not be categorized because of insufficient data. Water Quality Standards include strict rules about the number of samples required to determine whether a segment is impaired or meeting standards.

Segments listed as waters of concern have data that indicate a problem, but not enough data to make a determination of impairment.



Water Quality Impairments; Bacteria

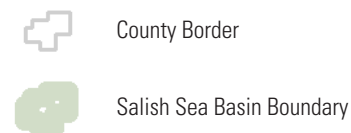
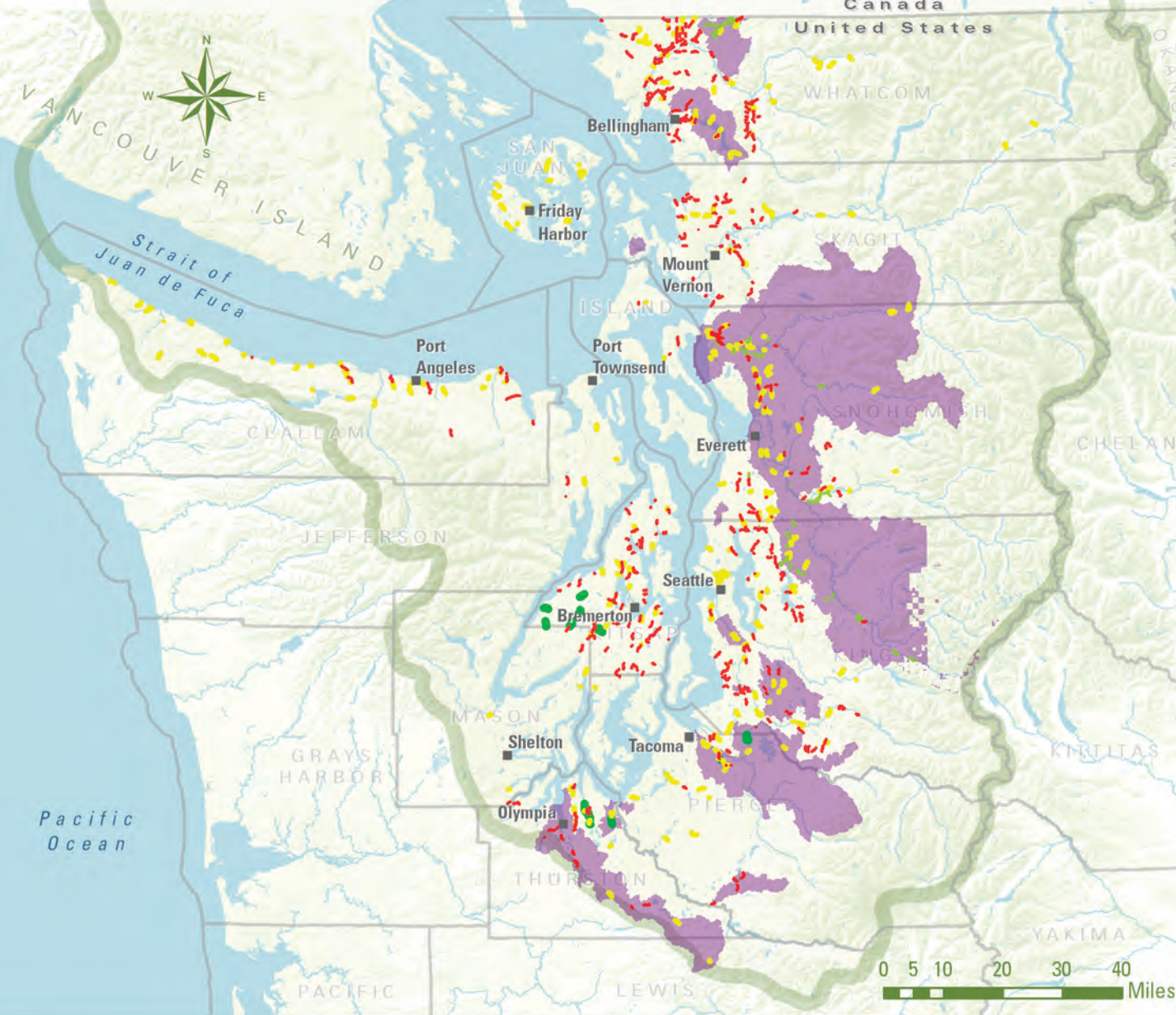
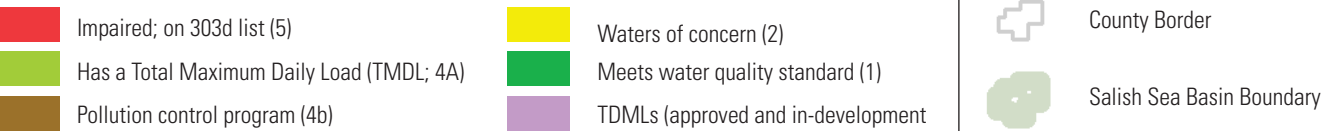


Figure 2. Rivers and stream segments listed as impaired for bacteria.

Source: Washington State's Water Quality Assessment and 303(d) list.



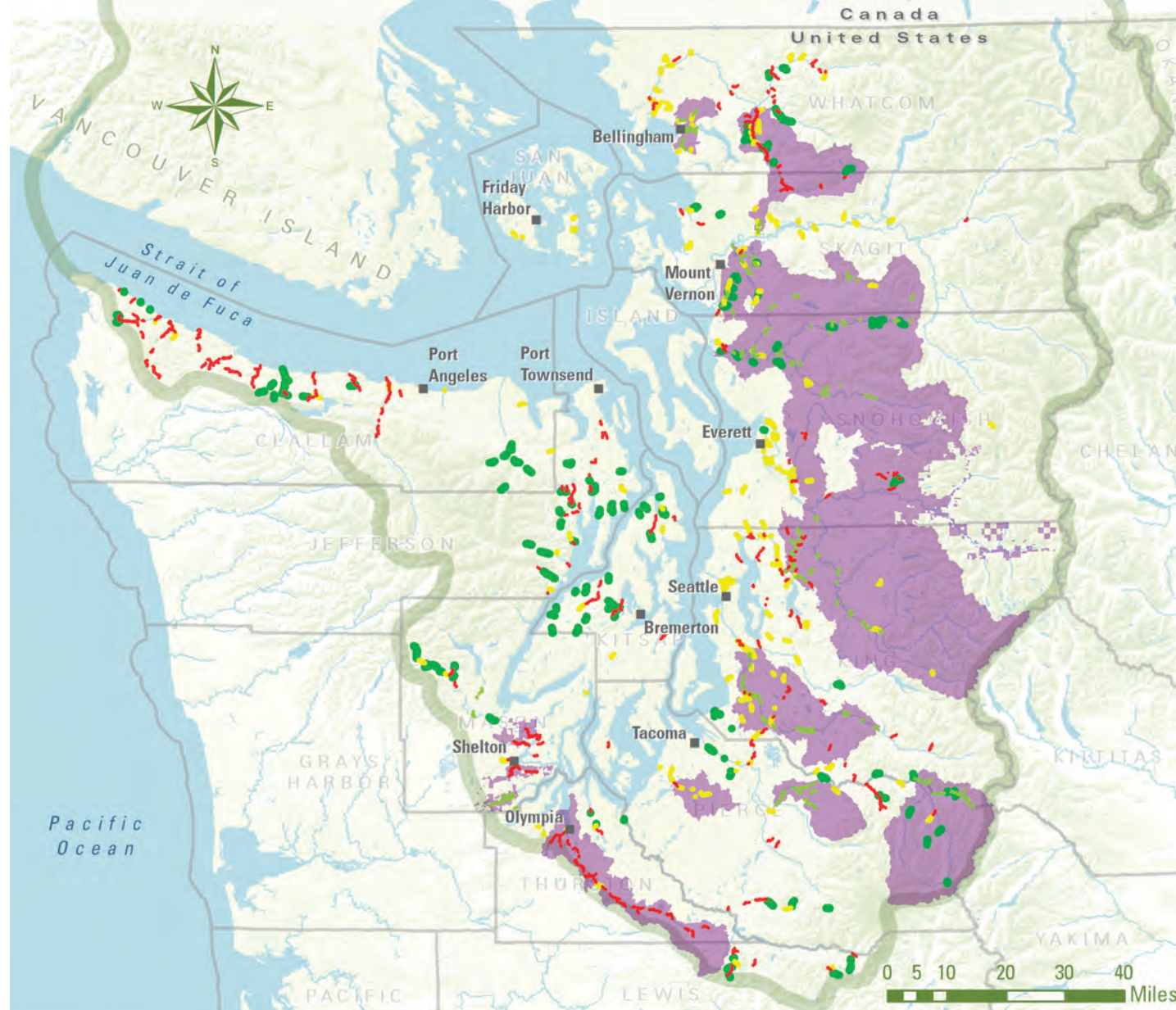
Water Quality Impairments: Dissolved Oxygen



Sampling of streams, rivers, and lakes tends to focus in areas with known problems; therefore, not all segments have been assessed, and some impairments may be missed. Consequently, impairment data are not a complete reflection of the overall health of all streams, rivers, and lakes in Puget Sound watersheds.

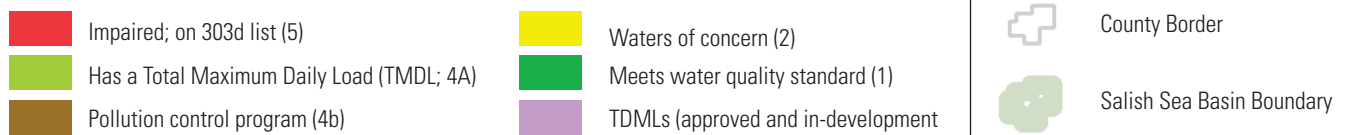
In addition, selection of monitoring sites is frequently constrained by funding. Monitoring efforts are split between monitoring established sites and looking for new problems. This limits the numbers of new waters that are addressed during a cycle.

Figure 3. Rivers and stream segments listed as impaired for dissolved oxygen.
Source: Washington State's Water Quality Assessment and 303(d) list.



Water Quality Impairments: Temperature

Figure 4. Rivers and stream segments listed as impaired for temperature. Source: Washington State's Water Quality Assessment and 303(d) list.



Freshwater Quality

INDICATOR:

Benthic Index of Biotic Integrity (B-IBI)

Indicator lead: Jo Wilhelm, King County

TARGET:

Protect small streams that are currently ranked “excellent” by B-IBI for biological condition; and improve and restore streams ranked “fair” so their average scores become “good.”

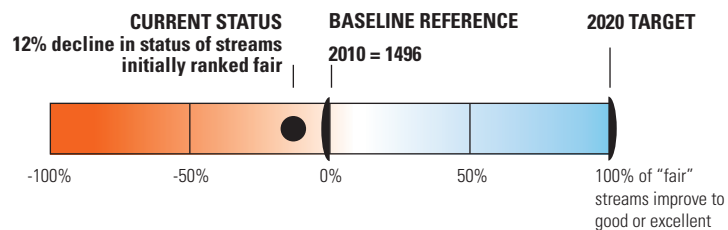
PROGRESS:

IS THE
TARGET MET?

NO

IS THERE
PROGRESS?

NO



For 128 sites with repeat visits during the last five years (2007 – 2011) more declined in condition to “poor” or “very poor” (26 sites) than improved to “good” or “excellent” (11 sites).

Progress Towards 2020 Target

No progress has been made. Overall, there was a net decline in condition of 12% of the 128 streams initially ranked “fair.”

From 2007-2011, a total of 245 stream sites were sampled more than once. Of these, a total of 91 sites had B-IBI scores indicating “fair” condition. Of these, 11 sites improved and changed categories to “good” or “excellent.” In contrast, a total of 26 stream sites declined and changed from “fair” to “poor” or “very poor.”

For the streams with “excellent” biological condition as rated by B-IBI, some streams are already protected. A detailed analysis has not been done to identify which streams and watersheds should be protected for this target. The watersheds will likely be small, five to 20 square miles.

What is This Indicator?

The indicator is the Benthic Index of Biotic Integrity (B-IBI). This index describes the biological condition of stream sites and their surrounding habitat based on the diversity and relative abundance of the benthic (bottom dwelling) macroinvertebrates living there, such as mayfly larvae, stonefly larvae, caddisfly larvae, worms, beetles, snails, dragonfly larvae, and many others.

Ten measures of biological condition are scored and summarized as the B-IBI, which ranges from a score of 10, indicating a very poor stream condition, to 50, indicating excellent condition.

B-IBI data are routinely collected and reported by more than 20 local jurisdictions, tribes, and other state and federal organizations in Puget Sound for a variety of reasons. In contrast, the Washington State Department of Ecology sampled 50 randomly-selected stream sites in 2009 and will sample again in 2013 to assess status and trend at the regional scale. Snohomish and King Counties also randomly select stream sites and report unbiased estimates of regional stream condition using B-IBI. For 84 sites with long-term data in King County, B-IBI scores for 68 sites did not change (81%), ten improved (12%), and six declined (7%).

Interpretation of Data

Status and trend

Biological condition ranged from very poor to excellent for streams assessed between 2007 and 2011. The majority of streams (88%) rated very poor, poor or fair, while fewer than 12% of streams were rated as good or excellent (Figure 1).

Not surprisingly, B-IBI scores were lower in areas with greater urban development (Figure 2). B-IBI is highly correlated with development and component metrics respond to specific aspects of disturbance. For example, long-lived species tend to decline as stream flows become higher in wet periods and lower in dry periods. Stoneflies also decline when natural vegetation near the stream is removed. Stream invertebrates are also sensitive to sediment, toxics, increased temperatures, and loss of habitat.

For sites with repeat visits during the last five years, more sites have declined in biological condition from “fair” to “poor” or “very poor” (29%)

than have improved to “good” or “excellent” condition (9%; Figure 3). These B-IBI scores were not derived from a random sample design and, therefore, do not necessarily represent the entire Puget Sound area.

B-IBI scores by category of biological condition for Puget Sound streams Annual, 2007-2011

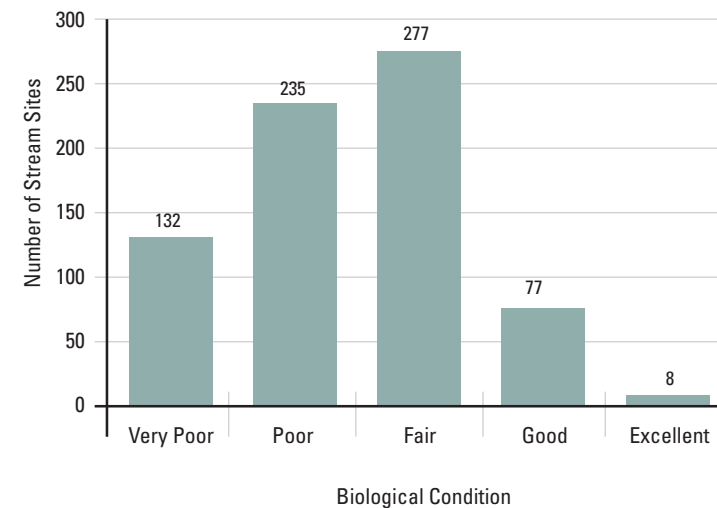


Figure 1. B-IBI scores by category of biological condition for Puget Sound streams. Shown are most recent data for each site.

Source: Puget Sound Stream Benthos

Freshwater Quality

B-IBI scores for 128 streams in Puget Sound
Annual, 2007-2011

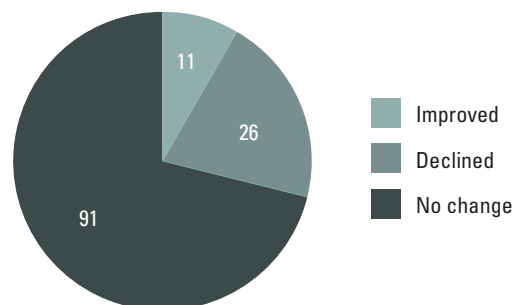
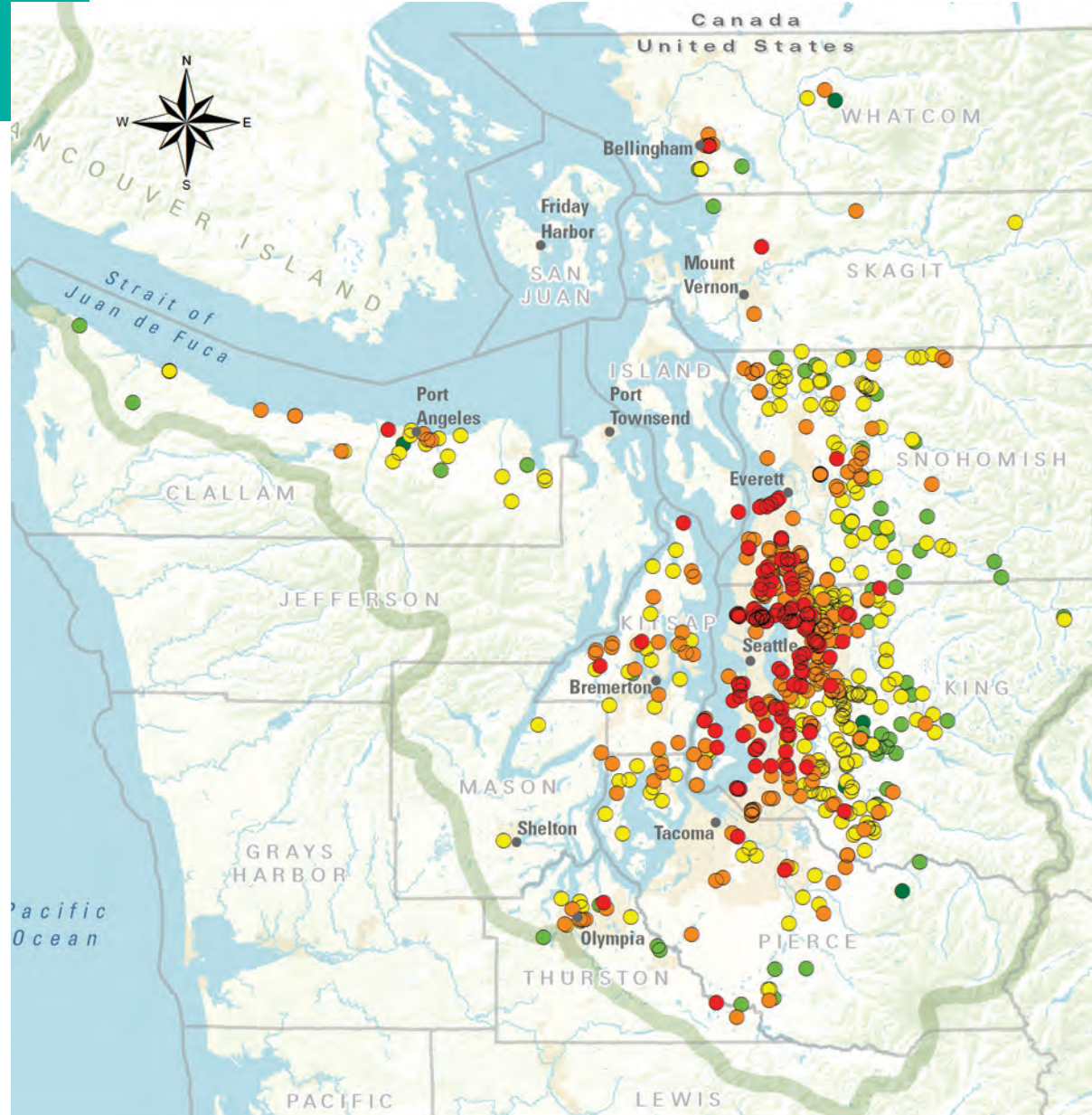


Figure 3. From 2007–2011, B-IBI was measured more than once at 245 sites. Of these, 128 stream sites were rated as “fair” by B-IBI for the first visit. Of these, 11 improved in condition to “good” or “excellent” condition; 26 declined in condition to “poor” or “very poor;” and 91 were still rated as “fair.”

Sources: Puget Sound Stream Benthos

Figure 2. B-IBI scores for rivers and streams in the Puget Sound watershed
Source: Puget Sound Stream Benthos



Biological Condition

- Very Poor
- Poor
- Fair
- Good
- Excellent

- County Border
- Salish Sea Basin Boundary
- Cities and Urban Growth Areas